

## CLAIMS

What is claimed is:

1. An apparatus comprising:

a first diffractive holographic data storage device having a first set of holograms

5 stored thereon;

a second diffractive holographic data storage device having a second set of holograms stored thereon; and

an opaque layer disposed between and attached to one side of the first and second diffractive holographic data storage devices.

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2. The apparatus according to claim 1 wherein the first and second diffractive holographic data storage devices are reflective holograms.

3. The apparatus according to claim 2 wherein the first and second diffractive holographic data storage devices include multiplexed holograms.

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4. The apparatus according to claim 3 wherein the multiplexed holograms are angularly multiplexed.

5. The apparatus according to claim 1 wherein the first and second diffractive holographic data storage devices include an organic material.

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6. The apparatus according to claim 5 wherein the organic material is a polypeptide material.

7. An apparatus comprising:

a reflective diffractive holographic data storage device having a first set of holograms stored thereon; and

a transmissive diffractive holographic data storage device having a second set of

5 holograms stored thereon, the transmissive and reflective diffractive holographic data storage devices being attached together.

8. An apparatus for reading a double-sided diffractive holographic data storage device having first and second reflective holograms stored on first and second sides  
10 respectively, comprising:

a multi-scanning device for directing a reference beam incident on one of the first and second sides at a predetermined angle; and

a detecting device for detecting the reference beam reflected from the storage device.  
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9. The apparatus according to claim 8 further comprising a rotating unit for rotating the double-sided diffractive holographic data storage device into first and second positions.

10. The apparatus according to claim 9 wherein the rotating unit is in the first position when the reference beam is incident upon the first side and the detecting device  
20 detects a first diffractive data output packets produced by reflective diffraction from the first side.

11. The apparatus according to claim 9 wherein the rotating unit is in the second position when the reference beam is incident upon the second side and the detecting

device detects a second data packet output produced by reflective diffraction from the second side.

12. The apparatus according to claim 8 wherein the first and second reflective holograms are angularly multiplexed holograms.

5           13. The apparatus according to claim 8 wherein the double-sided device includes an organic material.

14. The apparatus according to claim 13 wherein the organic material is a polypeptide.

10           15. The apparatus according to claim 8 wherein the reference beam is coherent or incoherent.

16. An apparatus for reading dual layer located on a diffractive device comprising:  
a first multi-scanning device for directing a first read beam incident upon a first side of the diffractive device at a first predetermined angle;

15           a second multi-scanning device for directing a second read beam incident upon a second side of the diffractive device at a second predetermined angle;

a first detecting device for detecting a first diffractive packet data output formed by the first reflectively diffracted read beam reflectively diffracted from the first side; and

a second detecting device for detecting a second diffractive holographic image formed by the second reflectively diffractive read beam reflected from the second side.

17. The apparatus according to claim 16 wherein the first read beam is generated from a coherent or non-coherent light having a same wavelength as a recording light.

18. The apparatus according to claim 16 wherein the second read beam is coming from a laser or a portion of the first read beam is coming through a beam splitter.

5        19. The apparatus according to claim 16 wherein the dual layer located on double-faced plate is an angularly multiplexed hologram.

20. The apparatus according to claim 16 wherein the reference beam is coherent or incoherent.

21. An apparatus comprising:

10        a diffractive holographic data storage device having a first side with a reflective hologram stored thereon and a second side with a transmissive hologram stored thereon;

      a multi-scanning device for directing a read beam incident on the first side, wherein a first portion of the read beam forms a first diffractive holographic image, wherein the image is produced by reflective diffraction from the first side, and wherein a second portion  
15 of the read beam is transmitted through the diffractive holographic data storage device and forms a second diffractive holographic image;

      a first detector for detecting output data packet produced by reflective diffraction from the first side; and

      a second detector for detecting the output data packet produced by transmission  
20 diffraction from the second side.

22. The apparatus according to claim 21 wherein the read beam is generated from a coherent light source.

23. The apparatus according to claim 21 wherein the first output data packet is generated by reflective diffraction from the first side reflective holography.

5           24. The apparatus according to claim 21 wherein the second output data packet is generated by transmissive diffraction from the second side through transmissive holography.

25. A holographic device comprising:

          a first holographic unit having a first front surface and a first back surface wherein a  
10   reflective hologram is formed by interference between object and reference beams on the first front surface; and

          a second holographic unit having a second front surface and a second back surface wherein a transmissive hologram is formed on the second front surface, the second front surface being attached to the first back surface.

15           26. The apparatus according to claim 25 wherein a reference beam is directed to the first front surface to generate the reflective hologram reflectively diffracted from the first surface, and the transmissive hologram is transmitted through the second holographic unit and emitted out of the second back surface.

20           27. The apparatus according to claim 26 wherein the reflective hologram is formed by object and reference beams directed to the first front surface and the transmissive

hologram is formed by the reference beam directed to the second front surface and the object beam directed to the second back surface.

28. The apparatus according to claim 24 wherein the first and second holographic units each comprise at least two layers, the first layer comprising a thin film of holographic recording material and the second layer comprising a substrate.

29. The apparatus according to claim 28 wherein the holographic recording material is an organic material.

30. The apparatus according to claim 29 wherein the organic material is a polypeptide.

31. The apparatus according to claim 25 wherein the first or second holographic device is angularly multiplexed.

32. A method comprising:  
providing a first holographic data storage device having a first set of holograms stored thereon;  
providing a second holographic data storage device having a second set of holograms stored thereon;  
disposing an opaque layer between the first and second holographic data storage devices; and  
attaching the opaque layer to one side of the first and second holographic data storage devices.

33. The method according to claim 32 wherein the first and second holographic data storage devices are reflective holograms.

34. The method according to claim 33 wherein the first and second holographic data storage devices include multiplexed holograms.

5        35. The method according to claim 34 wherein the multiplexed holograms are angularly multiplexed.

36. The method according to claim 32 wherein the first and second holographic data storage devices includes an organic material.

10       37. The method according to claim 36 wherein the organic material is a polypeptide material.

38. The method according to claim 32 wherein the first holographic data storage device is a reflective hologram and the second is a transmissive hologram.

15       39. A method for reading a double-sided holographic data storage device having first and second reflective holograms stored on first and second sides respectively, comprising:

directing a reference beam incident on one of the first and second sides at a predetermined angle; and

detecting the reference beam reflectively diffracted from the storage device.

40. The method according to claim 39 further comprising rotating the double-sided diffractive holographic data storage device into first and second positions.

41. The method according to claim 40 wherein the rotating is in the first position when the reference beam is incident on the first side and the detecting device detects a  
5 first output data packet produced by reflective diffraction from the first side.

42. The method according to claim 40 wherein the rotating unit is in the second position when the reference beam is incident upon the second side and the detecting device detects a second holographic image reflectively diffracted from the second side of the holographic storage device.

10 43. The method according to claim 39 wherein the first and second reflective holograms are angularly multiplexed holograms.

44. The method according to claim 39 wherein the double-sided device includes an organic material.

45. The method according to claim 39 wherein the organic material is a  
15 polypeptide.

46. The method according to claim 39 wherein the reference beam is coherent or incoherent light beam.



47. A method for reading a double-sided hologram comprising:

directing a first read beam incident upon a first side of the hologram at a first predetermined angle;

directing a second read beam incident upon a second side of the hologram at a

5 second predetermined angle;

detecting a first output data packet produced by reflective diffraction of the first read beam from the first side; and

detecting a second output data packet produced by the reflective diffraction of the second read beam from the second side.

10 48. The method according to claim 47 further comprising generating the first read beam from a light source having a same wavelength as a recording wavelength.

49. The method according to claim 47 further comprising generating the second read beam, the second read beam being a portion of the first read beam.

15 50. The method according to claim 47 wherein the double-sided hologram is an angularly multiplexed hologram.

51. The method according to claim 47 wherein the first read beam is a coherent or incoherent light beam.

52. A method for reading data comprising:

providing a holographic data storage device having a first side with a reflective hologram

20 stored thereon and a second side with a transmissive hologram stored thereon;

directing a read beam incident on the first side, wherein a first portion of the read beam forms a first output data packet produced by reflective diffraction from the first side, and wherein a second portion of the read beam is transmitted through the holographic data storage device and forms a second output data packet;

- 5        detecting the output data packet produced by reflective diffraction; and  
      detecting the output data packet produced by transmissive diffraction from the second side.

53. The method according to claim 52 wherein the read beam is generated from a coherent light source.

- 10       54. The method according to claim 52 wherein the first diffractive output data packet is generated by the reflective hologram.

55. The method according to claim 52 wherein the second diffractive output data packet is generated by the transmissive hologram.

56. A method comprising:

- 15       providing a first holographic unit having a first front surface and a first back surface wherein a reflective hologram is formed on the first front surface; and  
      providing a second holographic unit having a second front surface and a second back surface wherein a transmissive hologram is formed on the second front surface; and  
      attaching the second front surface to the first back surface of the first holographic  
20    unit.

57. The method according to claim 56 wherein a reference beam is directed to the first front surface to generate the reflective hologram reflected from the first surface, and the second hologram is transmitted through the second holographic unit and emitted out of the second back surface.

5 58. The method according to claim 57 wherein the reflective hologram is formed by object and reference beams directed to the first front surface and the transmissive hologram is formed by the reference beam directed to the second front surface and the object beam directed to the second back surface.

59. The method according to claim 55 wherein the first and second holographic  
10 units each comprise at least two layers, the first layer comprising a thin film of holographic recording material and the second layer comprising a substrate.

60. The method according to claim 58 wherein the holographic recording material is an organic material.

61. The method according to claim 69 wherein the organic material is a  
15 polypeptide.